GRAPHENE ASSOCIATED WITH NANOMATERIAL FOR PESTICIDE REMOVAL

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ABSTRACT

Pesticides are important agricultural pollutants as they are toxic, bioaccumulative and generally persistent in the environment. Therefore, these is a necessity to develop efficient remediation techniques to get rid of the pesticides in water. Adsorption using graphene-based magnetic materials is promising for the removal of such pollutants from water and wastewaters. Indeed, the use of such adsorbents offers a number of advantages such as high surface areas, high capacity and easy separation from the treated water. The present work is intended to the study of the adsorption process for glyphosate, a notorious largely used pesticide over graphene-iron oxide nanoparticles composite material.

INTRODUCTION

Problem - Water contamination by pesticides.

Cause - Agricultural activity has increased the use of pesticides, which contribute to the increase of environmental contamination.

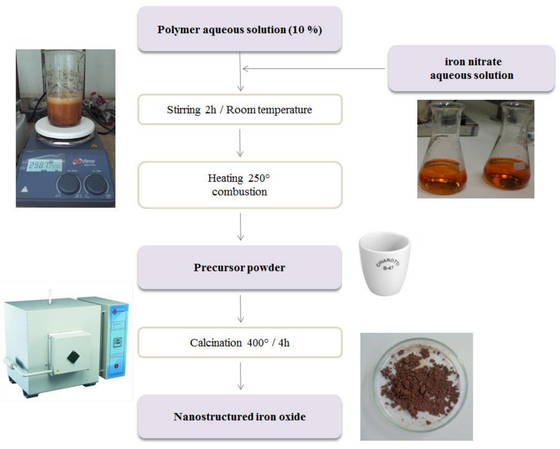
Proposed Treatment Method - Adsorption method to remove pesticides water using adsorbent composed of graphene and magnetic nanoparticles .

OBJECTIVES

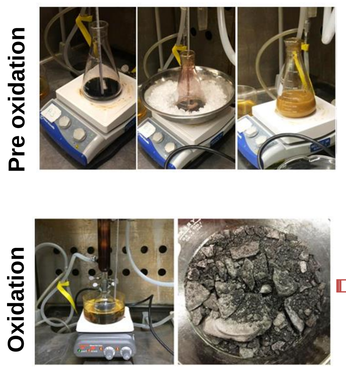
The objective of this study is to use the combination of graphene's properties with the potential of magnetic nanoparticles of iron oxide to enhance the efficiency of the adsorption process of glyphosate the in water and to facilitate the separation of the adsorbent through magnetic field.

MATERIALS AND METHODS

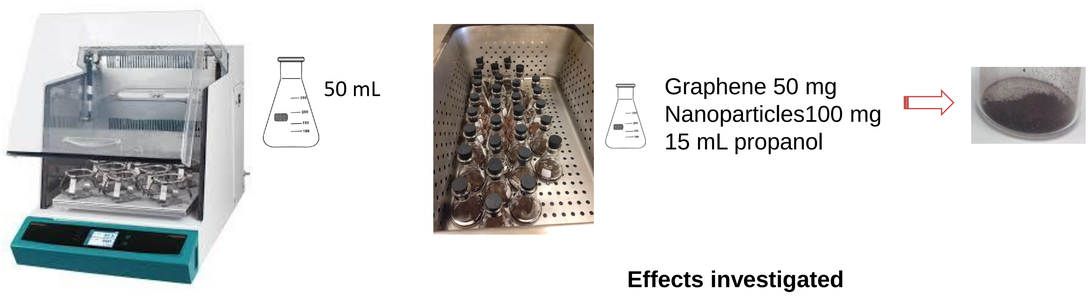
Synthesis of nanoparticles



Synthesis of graphene oxide



Preparation of magnetic adsorbent



Adsorption tests – Batch mode
Analysis – Ionic HPLC

Effects investigated
- Temperature
- Concentration

RESULTS

Figure 1- Glyphosate adsorption isotherms on GO-α-γ-Fe_2O_3 at different temperatures.

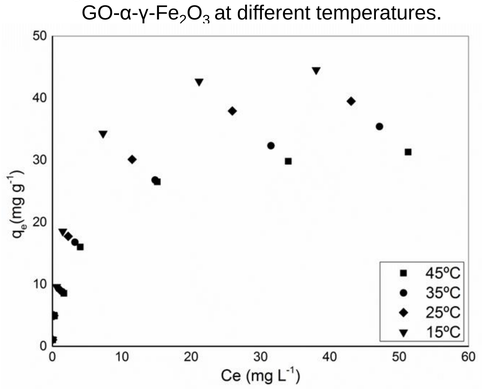


Figure 2- Isotherm models fitting for glyphosate adsorption on GO-α-γ-Fe_2O_3 at 15 ºC.

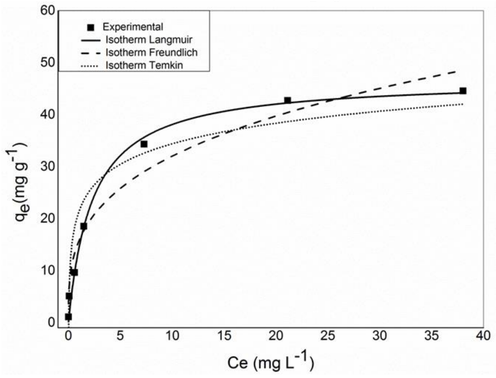
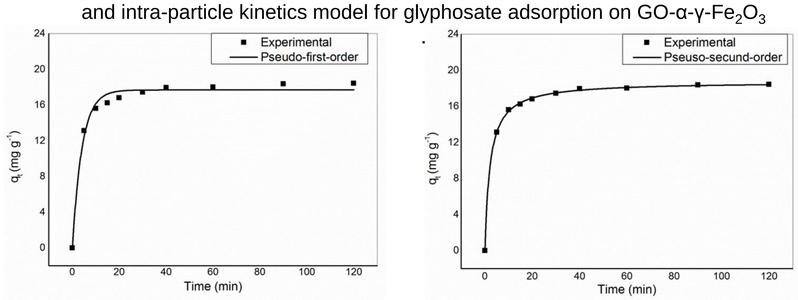


Figure 3- Pseudo-first-order kinetics model, pseudo-second-order kinetics model and intra-particle kinetics model for glyphosate adsorption on GO-α-γ-Fe_2O_3



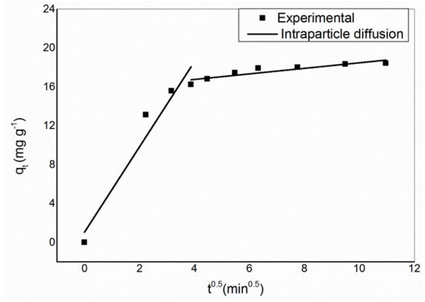


Table 1 - Langmuir, Freundlich and Temkin models parameters.

Models	15 ºC	25 ºC	35 ºC	45 ºC
Langmuir				
q_m(mg g^{-1})	46,844	41,925	36,951	33,875
K_L	0,436	0,295	0,237	0,228
R^2	0,990	0,988	0,984	0,988
Freundlich				
k_f	15,655	11,767	9,597	9,113
1/n	0,310	0,342	0,350	0,332
R^2	0,955	0,965	0,977	0,953
Temkin				
a_T	5,700	5.580	5,051	4,676
k_T (L mg^{-1})	41,818	17,960	13,250	12,273
R^2	0,896	0,903	0,919	0,922

Table 2 - Adsorption kinetics models parameters.

Experimental	q_t (mg g^{-1})
	18,433
Pseudo-first order	
K_1 (min^{-1})	0,244
$q_e$cal (mg g^{-1})	17,679
R^2	0,985
Pseudo-second order	
K_2 (g mg^{-1} min^{-1})	0,024
$q_e$cal (mg g^{-1})	18,733
R^2	0,999
Intraparticle diffusion	
K_1 (mg g^{-1} min$^{-0,5}$)	4,388
C_1	1,070
R^2	0,942
K_2 (mg g^{-1} min$^{-0,5}$)	0,227
C_2	16,150
R^2	0,837

Table 3 - Thermodynamic parameters.

Temperature (K)	ΔG (kj.mol^{-1})	ΔH (kj.mol^{-1})	ΔS (J mol^{-1} K^{-1})
288,15	-9,27		
298,15	-7,55	-37,65	-0,0100
308,15	-6,57		
318,15	-6,34		

CONCLUSIONS

Approximately 93% of glyphosate removal was observed. This study demonstrated that the new synthesized magnetic material GO-α-γ-Fe_2O_3 proved to be effective as a potential adsorbent for the removal of glyphosate from aqueous solution and a promising adsorbent for further utilization in water purification.

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